ET110

Source Apportionment of Regional Air Pollutant Fallout using Trace Element/Common Ion Measurements and Multi-Variate Receptor Modeling Methods

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Consice Description of Project Objective:

- Problem: It is extremely difficult to discern individual air pollutant source contributions to downwind fallout beyond short-range (50-km) distances because most air pollutants of concern (toxic metals, acid gases, mercury) are emitted by almost all industrial and urban source areas and because of mixing in the atmosphere. This problem is underlain by the INEEL's current lack of scientific understanding and R&D efforts in regional air pathway science.

- Current science: Univariate measurement of a few individual pollutant species, which cannot discern a source's contribution in the mixture, and air dispersion models which have large uncertainties beyond short-range distances and lack site-specific validation.

- **Objective:** Develop a new measurement-based method to characterize and source-apportion air pollutant fallout on a region-wide scale using multi-variate correlations of ultra-low trace element and common ion measurements in snowfall (a good air pollutant scavenger). The method uses: 1) upwind/downwind near-field sampling around source areas to determine background and source profile inputs, 2) inductively-coupled plasma-mass spectrometry (ICP-MS) to measure trace elements in the samples (standard IC for common ions), and 3) multi-variate regression statistical techniques (classical least-squares regression [CLS] modeling) to identify source area "profiles" (unique source-specific combinations of elements) and source apportion the fallout at any regional downwind sampling location.

- INEEL/DOE Value: Better understanding of regional contaminant air transport science. Demonstrate that pollutants from the INEEL are not transported beyond the Eastern Snake River Plain or into sensitive downwind ecosystems, which will enhance air permitting and stakeholder acceptance of existing and future EM-waste treatment operations. Provide a large baseline data set for evaluating future regional impacts and air model validation.

- National Value: Provide a basis for determining which sources should be regulated and controlled. Avoid costly over-controls on industries which have little impact. Provide a tool for assessing re-contamination of remediated Superfund sites.

Year-to-Date Accomplishments:

- Completed a training course in the exploratory data analysis program, Pirouette®.
- Analyzed remaining FY01 samples and compared INEEL vs. regional fallout (Figure 1).
- Identified crustal (blowing soil/dust) input and principal component (PCA) factors (unique correlations of elements that explain most of the variance) in FY01 data.
- Developed revised sampling methods using FY01 results (Figure 2).
    1. After major snowfall event, model airmass trajectories using NOAA INELVIS model from major ESRP source areas (IFA, POC, REX, BLA) and an INEEL source area (INTEC) (Figure 1).
    2. Select upwind/downwind sampling sites near source areas to characterize background inputs to source areas and emission "profile" (downwind minus upwind concentrations).
    3. Select downwind "mixing" sampling sites at locations where modeled trajectories from two or more source areas overlap.
    4. Collect samples from fresh (< 1 day old) snowfall and pre-filter to 0.8 um to reduce crustal component.
- Collected 135 new samples after three precipitation events (Jan 28, Feb 20, and Mar 7) using above methods. Samples were sent to the US Geological Survey National Research Laboratory for analysis.

- Submitted abstract for full paper presentation at the Air Quality III conference - Trace Elements and Common Ions in Southeastern Idaho Snow: Regional Air Pollutant Tracers for Source Area Emissions.

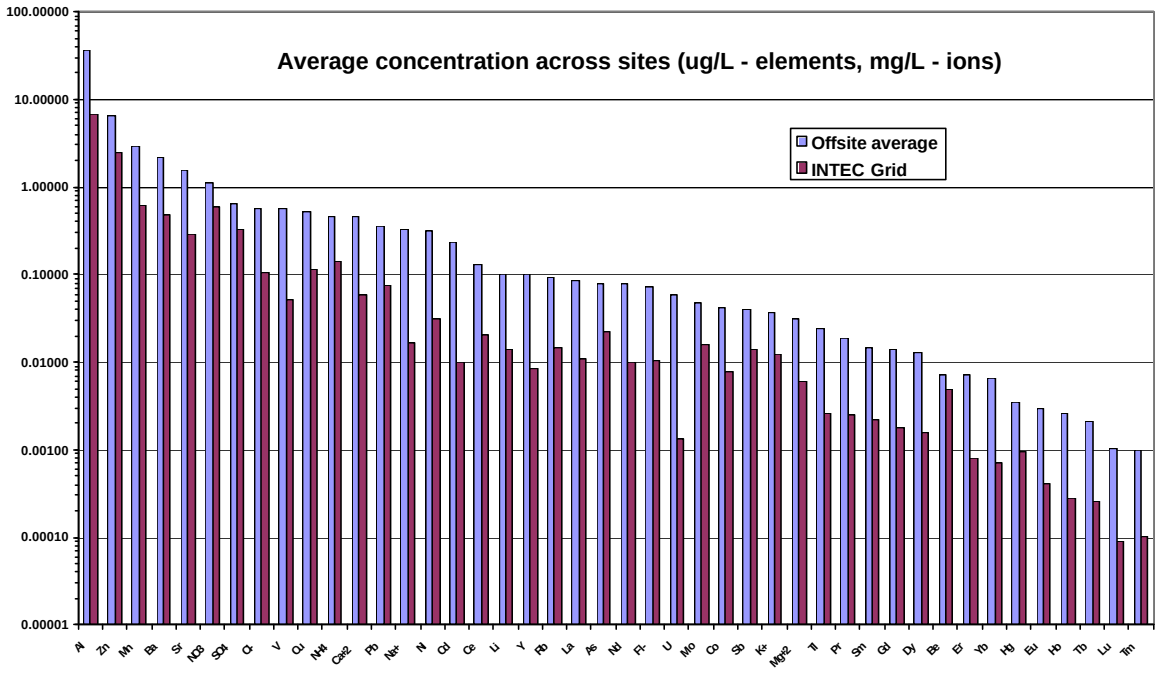

Figure 1. Comparison of trace element and common ions mass fractions in fallout at the INEEL (INTEC Grid) and across the ESRP (individual source area and site variability comparisons were also made).

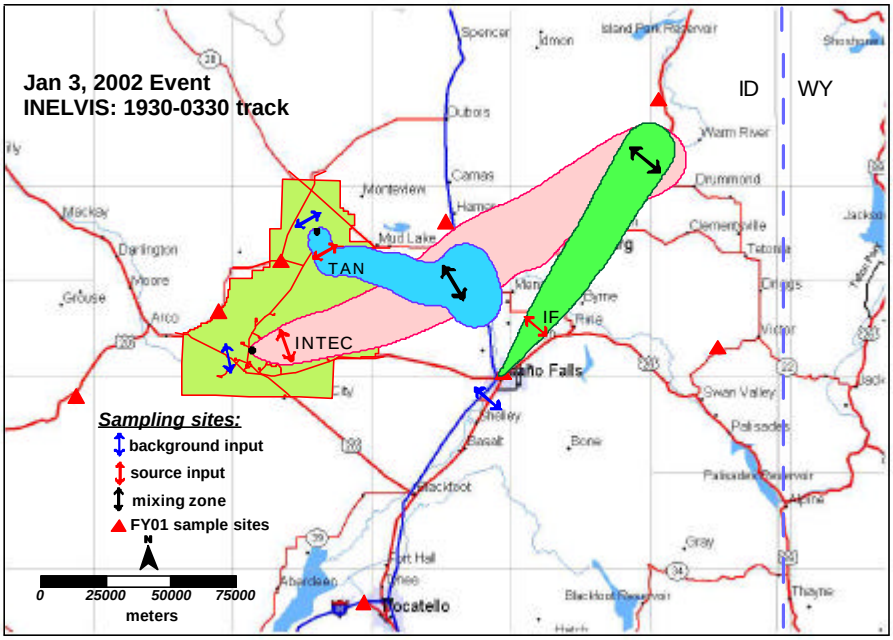

Figure 2. Revised sampling method uses INELVIS trajectory modeling immediately after a precipitation event to identify optimum source area profile and mxing zone sampling locations.

Probability of success: Very good for improvement in the scientific understanding of regional atmospheric pollutant transport and chemistry. Moderate for source apportionment based on FY01 results and success of revised FY02 sampling methods. One area of concern whether we obtained an adequate numbers of samples to account for site-specific sample variability. This was addressed by taking triplicate samples at two different spacings for three discrete sampling events. Analytical results for the FY02 samples are expected by June 14, 2002.

Milestones: Paper presentation and annual report are on schedule.

Planned Activities:

1. Submit a proposal to EPA in April for application of this technique at the Herculaneum (MO) lead smelter Superfund site. We currently have external funding through Superfund Technical Support to support this site for other activities, and EPA has expressed interest in assessing the source of re-deposited lead in downwind remediatiion areas. The site has received high national (CNN) media coverage.
2. Upon receipt of analytical results (June), evaluate source area profiles, develop a CLS model using Pirouette®, evaluate source contributions at mixing zone sample sites, evaluate results.
3. Complete paper for presentation at the Air Quality III conference (September 10-12, 2002).

Issues: None

Budget Status:

The project has a year-to-date variance of (12.7%) (overspent). This variance will be reduced to within 10% by the end of March due to reduced labor hours in the last two weeks.